Amendments to the Claims

The listing of claims will replace all prior versions, and listings of claims in the application.

1.   (Currently Amended) A system for recovering timing information from a serial data signal, comprising:

a phase interpolator adapted to derive a <u>data</u> sampling signal <u>and a phase sampling signal each</u> having an interpolated phase ~~in response~~ <u>responsive</u> to a plurality of <u>phase</u> control signals<u>, wherein the phase sampling signal is offset in phase relative to the data sampling signal by a predetermined amount</u>; ~~and~~

~~a controller including~~

a data path adapted to sample the serial data signal according to the <u>data</u> sampling signal <u>to produce a data signal</u>;[[,]]

<u>a phase path adapted to sample the serial data signal according to the phase sampling signal to produce a phase signal;</u>

a phase detector adapted to <u>produce a phase error signal based on the data signal and the phase signal, wherein the phase error signal is indicative of a phase offset between the data sampling signal and the serial data signal;</u> ~~detect a phase offset between the sampling signal and the serial data signal,~~

a phase error processor coupled to the phase detector and adapted to <u>produce a frequency offset estimate signal based on long-term error processing of the phase error signal, wherein the frequency offset estimate signal is indicative of</u> ~~estimate~~ a frequency offset between the <u>data</u> sampling signal and the serial data signal<u>;</u> ~~based on the phase offset,~~

a command generator coupled to the phase error processor and adapted to generate a rotator control signal in response to the frequency offset estimate <u>signal;</u>[[,]] and

a control signal rotator adapted to manipulate the <u>plurality of phase</u> control signals in response to the rotator control signal, whereby the ~~controller~~ <u>control signal</u>

rotator is adapted to cause[[s]] the phase interpolator to rotate the interpolated phase of the data sampling signal and the phase sampling signal at a rate corresponding to the frequency offset.

2.   (Currently Amended) The system of claim 1, wherein A system for recovering timing information from a serial data signal, comprising:

a phase interpolator adapted to derive a sampling signal having an interpolated phase; and

a controller coupled to the phase interpolator and including

the control signal rotator a phase error processor is adapted to derive an estimate of a frequency offset between the sampling signal and the serial data signal, the controller being adapted to cause the phase interpolator to rotate the interpolated phase of the data sampling signal and the phase sampling signal at a rate corresponding to the frequency offset so as to reduce the frequency offset between the data sampling signal and the serial data signal.

3.   (Currently Amended) The system of claim [[2]] 1, wherein the controller control signal rotator causes the phase interpolator to repetitively rotate the interpolated phase of the data sampling signal and the phase sampling signal through a range of phases spanning 360° at the rate corresponding to the frequency offset.

4.   (Currently Amended) The system of claim [[2]] 3, wherein the control signal rotator controller includes logic is adapted to cause the phase interpolator to:

rotate the interpolated phase of the data sampling signal and the phase sampling signal in a direction of increasing phase to decrease a frequency of the data sampling signal and the phase sampling signal when the frequency offset estimate signal indicates [[a]] the frequency of the data sampling signal is greater than a frequency of the serial data signal; and

rotate the interpolated phase of the data sampling signal and the phase sampling signal in a direction of decreasing phase to increase the frequency of the data sampling signal and the phase sampling signal when the frequency offset estimate signal indicates

the frequency of the <u>data</u> sampling signal is less than [[a]] <u>the</u> frequency of the serial data signal.

5.   (Currently Amended) The system of claim [[2]] <u>1</u>, wherein the phase interpolator ~~includes~~ <u>comprises</u>:

a plurality of reference stages adapted to control individual magnitudes of a plurality of component signals having different phases responsive to ~~a~~ <u>the</u> plurality of <u>phase</u> control signals; and

a combining node adapted to combine the plurality of component signals into the interpolated <u>data</u> ~~timing~~ <u>sampling</u> signal.

6.   (Cancelled)

7.   (Cancelled)

8.   (Currently Amended) The system of claim [[2]] <u>1</u>, wherein the ~~controller~~ <u>control signal rotator</u> is adapted to apply a plurality of phase control signals to the phase interpolator to control the interpolated phase of the <u>data</u> sampling signal <u>and the phase sampling signal</u>, ~~the controller being adapted to manipulate the plurality of phase control signals, and correspondingly, the interpolated phase of the sampling signal,~~ based on the rotator control signal ~~frequency offset estimate~~.

9.   (Currently Amended) The system of claim 8, wherein the ~~controller~~ <u>control signal rotator</u> is adapted to rotate the plurality of phase control signals, and correspondingly, the interpolated phase of the <u>data</u> sampling signal <u>and the phase sampling signal</u> according to the rotator control signal ~~frequency offset estimate~~.

10.   (Currently Amended) The system of claim [[2]] <u>1</u>, wherein the ~~controller further includes:~~

~~a command generator coupled to the phase error processor and adapted to generate a rotator control signal in response to the frequency offset estimate; and~~

[[a]] control signal rotator is adapted to apply a the plurality of phase control signals to the phase interpolator to control the interpolated phase of the data sampling signal and the phase sampling signal, the control signal rotator being adapted to rotate the plurality of phase control signals, and correspondingly the interpolated phase of the data sampling signal and the phase sampling signal, at the rate corresponding to the frequency offset, responsive to the rotator control signal.

11.   (Currently Amended) The system of claim 10, wherein the rotator control signal is one of a phase-advance, a phase-retard, and a phase-hold signal, the phase control signal rotator being adapted to:

rotate the plurality of phase control[[s]] signals in a first direction to advance the interpolated phase of the data timing signal and the phase sampling signal in response to the phase-advance signal;

rotate the plurality of phase control[[s]] signals in a second direction to retard the interpolated phase of the data timing signal and the phase sampling signal in response to the phase-retard signal; and

prevent the plurality of phase control signals and correspondingly the interpolated phase of the data timing signal and the phase sampling signal from rotating in response to the phase-hold signal.

12.   (Currently Amended) A method of recovering timing information from a serial data signal, comprising:

(a)   deriving a data sampling signal and a phase sampling signal each having an interpolated phase, wherein the phase sampling signal is offset in phase relative to the data sampling signal by a predetermined amount;

(b)   sampling the serial data signal according to the data sampling signal to produce a data signal;

(c)   sampling the serial data signal according to the phase sampling signal to produce a phase signal;

(d)   producing a phase error signal based on the data signal and phase signal, wherein the phase error signal is indicative of a phase offset between the data sampling signal and the serial data signal;

(b)(e)   estimating a frequency offset between the data sampling signal and the serial data signal based on long-term processing of the phase error signal; and

(c)(f)   rotating the interpolated phase of the data sampling signal and the phase sampling signal at a rate corresponding to the frequency offset, thereby to reduce reducing the frequency offset between the data sampling signal and the serial data signal.

13.   (Currently Amended) The method of claim 12, wherein step (b) (f) further comprises[[:]] rotating the interpolated phase of the data sampling signal and the phase sampling signal at a rate corresponding to the frequency offset.

          detecting a phase offset between the serial data signal and the sampling signal; and

          estimating the frequency offset based on the phase offset.

14.   (Currently Amended) The method of claim 12, wherein step (c)(f) further comprises repetitively rotating the interpolated phase of the data sampling signal and the phase sampling signal through a range of phases spanning 360° at the rate corresponding to the frequency offset.

15.   (Currently Amended) The method of claim 14, wherein step (c)(f) further comprises:

          rotating the interpolated phase of the data sampling signal and the phase sampling signal in a direction of increasing phase to decrease a frequency of the data sampling signal and the phase sampling signal when the frequency of the data sampling signal is greater than a frequency of the serial data signal; and

          rotating the interpolated phase of the data sampling signal and the phase sampling signal in a direction of decreasing phase to increase the frequency of the data sampling signal and the phase sampling signal when the frequency of the data sampling signal is less than the frequency of the serial data signal.

16.   (Currently Amended) The method of claim 12, wherein step (a) further comprises deriving the data sampling signal and the phase sampling signal phase responsive to a plurality of phase control signals, the method further comprising

manipulating the plurality of phase control signals responsive to the ~~phase~~ frequency offset.

17. (Currently Amended) The method of claim 16, wherein[[:]]

~~step (a) comprises deriving the sampling signal phase responsive to a plurality of phase control signals; and~~

step ~~(e)~~(f) further comprises rotating the plurality of phase control signals, and correspondingly, the interpolated phase of the data sampling signal and the phase sampling signal according to the frequency ~~phase~~ offset.

18. (Currently Amended) The method of claim 12, wherein step ~~(b)~~ (e) further comprises[[:]]

~~sampling the serial data signal according to the sampling signal, thereby producing serial data signal samples;~~

deriving a frequency error signal based on ~~indicative of~~ the frequency offset ~~between the timing signal and the serial data signal based on the serial data signal samples~~ and step (f) further comprises rotating the interpolated phase of the data sampling signal and the phase sampling signal according to the frequency error signal.

19. (Currently Amended) The method of claim 12, wherein step (a) further comprises:

controlling individual magnitudes of a plurality of component signals having different phases responsive to ~~a~~ the plurality of phase control signals; and

combining the plurality of component signals into the data sampling signal having the interpolated phase.

20. (Currently Amended) The method of claim 12, wherein step ~~(e)~~(f) comprises synchronizing ~~a~~ the frequency of the data sampling signal to ~~a~~ the frequency of the serial data signal.

21. (New) The system of claim 1, wherein the phase error processor comprises a long-term error processor, wherein the long-term error processor integrates

the phase error signal over a relatively long time period to cause the frequency offset estimate signal to respond slowly to changes in the phase offset between the data sampling signal and the serial data signal.

22.   (New) The system of claim 21, wherein the long-term error processor comprises an accumulator.

23.   (New) The system of claim 1, wherein the phase sampling signal is offset in phase relative to the data sampling signal by a predetermined amount corresponding to a fraction of a symbol period of the serial data signal.

24.   (New) The system of claim 30, wherein the phase sampling signal is offset in phase relative to the data sampling signal by one-half of a symbol period of the serial data signal.

25.   (New) The method of claim 12, wherein the long-term error processing of step (e) further comprises integrating the phase error signal over a relatively long time period to cause an estimate of the frequency offset to respond slowly to changes in the phase offset between the data sampling signal and the received serial data signal.

26.   (New) The method of claim 25, further comprising implementing the long-term error processing with an accumulator.

27.   (New) The method of claim 12, wherein step (a) further comprises offsetting the phase sampling signal in phase relative to the data sampling signal by a predetermined amount corresponding to a fraction of a symbol period of the serial data signal.

28.   (New) The method of claim 27, wherein step (a) further comprises offsetting the phase sampling signal in phase relative to the data sampling signal by one-half of a symbol period of the serial data signal.